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July 23, 2015

Division of Water Quality
Mr. Walter L. Baker, P.E., Director
P.O. Box 144870
Salt Lake City, Utah 84114-4870

Submitted Via Email:
Division of Water Quality
Mr. Mark Novak
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Mr. Dan Hall
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Ms. Jenny Potter, Support Services Supervisor
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Re: Hunt Consolidated, Inc.'s Supplemental Materials in Support of Comments Regarding Ground Water Discharge Permit and Related Construction Permit; Permit No. UGW070003

Gentlemen:

On June 12, 2015, Hunt Consolidated, Inc. ("Hunt") submitted preliminary comments ("Hunt's Comments") in response to the Utah Department of Environmental Quality's ("DEQ" or, the "Agency") solicitation of public comments pertaining to the ground water discharge permit and associated construction permit (collectively, "Permits"), sought by Green River Resources, Inc. ("GRR") and American Sands Energy Corp. ("ASE") (collectively, "ASE"). Hunt engaged the engineering consulting firm of Burns & McDonnell to assist in examining ASE's permit application materials and the Permits, and to provide technical information and scientific assessments in support of Hunt's Comments. Subsequent to submission of its Comments, Hunt informed Agency personnel that Hunt expected to receive further assessments

and technical materials pertaining to the Permits, from Burns & McDonnell. Agency personnel directed Hunt to submit such information to the Agency in order to ensure that the Agency examined all information material to its permitting decisions.

In response to the Agency's direction to submit supplemental information as it became available, Hunt has continued to work with Burns & McDonnell to obtain information that is material to the Agency in making its permitting decision, as quickly as possible. To that end, included with this letter is Burns & McDonnell's memorandum dated July 23, 2015, addressing "Geologic and Hydrogeologic Conditions, Potential Spring Impacts and Implications Relating the Protection of Class 1A Aquifer" ("Geologic and Hydrogeologic Memorandum," or "Memo"). Hunt anticipates that all remaining materials will be compiled and provided to the Agency by the end of business on July 31, 2015.

The attached Geologic and Hydrogeologic Memorandum addresses several points that are material to the Agency's permitting decisions. As a preliminary matter, the Agency prepared the draft Permit based on information provided by ASE in its Application. Utah Administrative Rule R317-6-6.3 requires application contents to include comprehensive studies of the geologic and hydrogeologic conditions at the proposed site. As the Memo explains, however, no comprehensive study of the geologic and hydrogeologic conditions at the site occurred. Absent site-specific information, the Agency cannot determine whether the proposed locations are appropriate for the proposed mine and impoundment.

Additionally, the Application failed to include the required closure and post-closure plans, violating the applicable regulation and leaving the Division unable to determine what groundwater impacts will occur post-closure. The Permit's attempt to remedy this failure by allowing later submission is illegal. *See* R317-6-6.3(S); R317-6-6.4.A.4 Other material deficiencies in the Permit include failure to require *adequate* monitoring, pursuant to R317-6-6.4.2; failure to use best available technology to minimize pollutant discharge, pursuant to R317-6-6.4.3; and failure to identify procedures that will ensure "there is no impairment of present and future beneficial uses of the groundwater," pursuant to R317-6-6.4.4. These and other errors and omissions are material to the Agency's permitting decision, and should be considered and resolved prior to issuing any permits.

As a property owner with substantial economic investment and resources dedicated to current operations on the land that will be adversely and irreparably affected by the activity proposed by the Permits, Hunt remains committed to opposing ASE's activities as currently proposed. Based on the questions left unresolved by the Application materials and Permit, and additional questions raised by the public comments submitted by Hunt and other parties in this matter, Hunt respectfully requests that the Agency examine the supplemental materials provided in conjunction with its Comments, and reassess its conclusions prior to issuing any Permit as currently drafted.

Finally, Hunt has retained additional assistance from two environmental lawyers who will be working on the issues presented at DEQ/DWQ. Blaine Rawson and Janelle Eurick Bauer, with the law firm of Ray Quinney & Nebeker, will be working alongside Hunt to ensure that the Permits comply with regulatory requirements and offer adequate protection to its water

resources. They will be in contact soon and will provide you with the necessary contact information.

Very truly yours,

WELBORN SULLIVAN MECK & TOOLEY, P.C.

Kelly A. Williams

cc: Mr. John Baza, DOGM
Mr. Paul Baker, DOGM
Mr. David Hernandez, V.P. & General Counsel, Hunt Consolidated, Inc.
Mr. Todd Watson,V.P., Hunt Realty
Mr. E. Blaine Rawson
Ms. Janelle Eurick Bauer

Memorandum

BURNS McDONNELL

Date: July 23, 2015

To: Todd Watson – Hunt Consolidated, Inc.
Martin Wouch, PE, CPEA – Hunt Consolidated, Inc.

From: Jeffrey Binder, PG
Steven Young, PG

Subject: Bruin Point Mine Evaluation – Geologic and Hydrogeologic Conditions, Potential Spring Impacts and Implications Relating to Protection of Class 1A Aquifer

The purpose of this technical memorandum is to provide comments related to the review of the American Sands Energy Corporation's Utah Groundwater Discharge Permit Application for the Bruin Point Mine, Carbon County, Utah prepared for Green River Resources, Inc. that was prepared by URS dated April 2015 (Application) and the Draft Groundwater Discharge Permit No. UGW070003 (Permit). The comments presented in this memorandum are primarily focused on geologic, hydrogeologic and hydrologic conditions at the proposed facility and adjacent properties and specific Permit provisions. The following is an outline of the topics covered in this document.

1. Review of the Permit
2. General Summary of Application Content Relating to Groundwater Conditions
3. Implications related to current geologic and hydrogeologic conditions relative to the potential degradation of the natural environment and protection of Class 1A aquifer
4. Data gaps and conclusions

Burns & McDonnell has performed similar evaluations and design work for mining and oil & gas projects across the United States. The qualifications of the principal authors of this memorandum are attached.

Review of the Permit

As a general comment, the Draft Permit was prepared based on the information included in the Application. As stated in the technical review of the Application provided below, there has been no comprehensive study of the geologic and hydrogeologic conditions at the site as required by Utah Administrative Rule R317-6-6.3 regarding application contents. In the absence of this site specific information, a thorough evaluation of whether this is an appropriate location for the proposed mine and impoundment cannot be made.

Section II.A of the Permit states that the "groundwater under the site is also likely to be Class 1A." The Permit does not include provisions for either establishing classification of groundwater beneath the site or requiring the proposed site facilities be protective of this Class 1A groundwater resource.

The Permit states that "***It is anticipated that there will be no impact to surface or groundwater because the mining and processing activities are designed to be zero discharge.***" While it may be true

that the design is intended to not allow discharge, the presumption that this design will be completely successful in the absence of an adequate understanding of the groundwater resource is unsupported. Furthermore the Permit does not address the fate and transport of contaminants resulting from a potential release from the facility either as a phase separate liquid or as contaminated groundwater or surface water. The permit does require a groundwater monitoring system be installed. However there is no provision for evaluating the groundwater conditions prior to installing that system so that both background and compliance well locations are acceptable. For these reasons, it does not seem appropriate to approve the construction until after a full understanding of the groundwater conditions has been completed and the adequacy of the engineering design as it relates to site specific groundwater conditions has been evaluated.

The draft Permit has several other deficiencies, including:

- Section II.A indicates that the groundwater at the North Spring located adjacent and downgradient of the impoundment location is designated Class 1A, Pristine and presumes that the groundwater "under the site is likely to be Class 1A." It would seem more appropriate and protective to require the permittee to establish groundwater classification at the site prior to finalizing groundwater monitoring plans.
- Section II.D.3.b only requires 3 quarters of sampling per year. This is presumably because of inclement weather issues. However reason for this is not stated. It would seem that if the weather permits mine operations, then monitoring of all aspects of the operation would also be important and achievable. Any monitoring must be "adequate to determine compliance with applicable requirements." R317-6-6.4.2.
- Section II.D.4 states that tailings will not be placed containing more than 10% water and not more than 25 ppm solvent. The value of 10% water likely represents as much as 2/3 of the amount of water required to saturate the sand and create conditions favorable for water movement under saturated conditions. This suggests that small errors in estimating or controlling water content could result in saturated conditions with respect to water in the sand. Saturated flow conditions greatly increase the potential for movement of water and dissolved solvent or bitumen constituents within the impoundment. The Division should require a lower percentage of water to provide a better margin of operation. A lower percentage of water would be consistent with the requirement to use "best available technology to minimize the discharge of any pollutant. R317-6-6.4.3.In addition, the value of 25 ppm of fugitive solvent is critical to the estimate of the overall retention of non-aqueous phase in the sand and is discussed in more detail in the review of the Application.
- Section II.D.4.a describes the process by which the moisture content of the sand being moved to the impoundment will be monitored. It does not address corrective actions that would be required if a load or many loads are found to be unsuitable for placement in the impoundment. A procedure describing how the offending load will be diverted and the moisture content violation remedied should be included in any final permit. Such a

procedure is necessary to ensure "there is no impairment of present and future beneficial uses of the groundwater." R317-6-6.4.4.

- Section II.D.4.b requires a visual inspection of sand by operations personnel. No mention of the required qualifications of these personnel is included and the requirements defining the "observed quality" of the sand are missing. This requirement as stated would not provide meaningful monitoring of the sand waste stream. Any monitoring must be "adequate to determine compliance with applicable requirements." R317-6-6.4.2.
- Section II.D.4.c requires monitoring of air quality above the sand pile but does not include any provision for corrective action in the event that a defined exceedance occurs. Recording the alarm condition and requiring that the "operators will intervene to reestablish proper sand drying practices" does not address concerns over continuing to place material that may have not been adequately treated. The procedure should also include corrective measures for material already placed in the impoundment that is presumably responsible for the alarm condition of solvent concentrations in outdoor air and may also be contributing to soil vapor contamination and groundwater impacts. Such a procedure is necessary to ensure "there is no impairment of present and future beneficial uses of the groundwater." R317-6-6.4.4.
- Section II.D.4.d describes a process for evaluating the quality of the sand being placed in the impoundment and correlating the measurement with the concurrent sand drying process. This is apparently intended to provide a mechanism for reducing the sand monitoring protocol in lieu of controls on the drying and treatment process. While the concept may have merit the requirements in this section are poorly defined. An evaluation such as this that could have important and long lasting impact on the contents of the material in the impoundment should include specific requirements for acceptable statistical methods and measurement of solvent, bitumen and water content. Any monitoring must be "adequate to determine compliance with applicable requirements." R317-6-6.4.2.
- Section II.D.5 requires that the retention basin be monitored for presence of water or solvent on a quarterly basis and includes a provision for modifying or eliminating the monitoring program after adequate monitoring has been completed. Again a modification may be appropriate but only following collection of sufficient data to characterize the performance of the drain system and the pond. However, because of the potential for change to subsurface conditions in the impoundment at any time in the future the cessation of monitoring the retention pond should not be an option. Any monitoring must be "adequate to determine compliance with applicable requirements." R317-6-6.4.2.
- In addition paragraph 2 of this section allows water from the retention basin to be applied to dry tailings. This may be an acceptable practice if the water contains no solvent compounds and all other constituents are within the established standards.

Otherwise recycling contaminated water from the retention pond onto the sand would only serve to concentrate contaminants in the sand and potentially in future drainage from the impoundment. This practice must be eliminated to ensure "there is no impairment of present and future beneficial uses of the groundwater." R317-6-6.4.4.

- Section II.D.6 requires organic vapor monitoring of the tile drain system in the impoundment. Monitoring is only required once per year and is allowed to be discontinued following 5 consecutive quarters of sampling following facility closure. This monitoring activity may actually provide an early warning system for solvent or bitumen compounds in the impoundment and should be considered as a more frequent test for changes conditions within the sand mass. Any monitoring must be "adequate to determine compliance with applicable requirements." R317-6-6.4.2.
- Section II.E.1.c is confusing and it is not clear what is required and how it relates to "Probable Out-of-Compliance Status".
- Section II.E.2.c requires a response to a confirmed out of compliance condition, however, it does not specify the disposition of ongoing operations. If the sand placement process continues when an out of compliance condition is identified, the Permit should specify cessation of placement or diversion of the waste stream until the cause of the compliance monitoring failure is identified. This practice is needed to ensure "there is no impairment of present and future beneficial uses of the groundwater." R317-6-6.4.4. This section includes provisions for corrective action if groundwater is impacted however although monitoring of other media such as soil gas, moisture content, and NAPL is required there are no specifications for corrective actions should the action levels be exceeded.
- Section II.F.2 requires reporting of groundwater elevation levels but does not include a provision for a groundwater potentiometric surface map. The water level data collected is critical to determining if the monitoring well network remains appropriately located to adequately monitor the groundwater moving under the impoundment. These maps should be required as part of the reporting process.
- Sections II.G.3 and II.G.4 require that conceptual and final closure plans be prepared after the start of processing and prior to ceasing operations. This is not consistent with Utah Administrative Rule R317-6-6.3.S requiring closure and post closure management plans that are protective of the groundwater be included as part of the Application.

While these observations represent concerns that were identified during this initial review of the draft Permit there may be other issues that should be addressed in the Permit in order to best protect the groundwater around the proposed mine. One such global concern is the potential for the mine itself and the waste that will be placed in the mine during later phases of mine operation to adversely impact groundwater. The mine will not have the advantage of an engineered impoundment system to mitigate any potential for solvent, bitumen or water migration either into or out of the closed mine. The Permit does not contain any provisions to protect against

"impairment of present and future beneficial uses of the groundwater" resulting from placing tailings back into the mine. R317-6-6.4.4.

General Summary of Application Content Relating to Groundwater Conditions

We believe that he information provided in the Application which was used to prepare the Permit does not provide a comprehensive understanding of the groundwater conditions at the site as required by Utah Administrative Rule R317-6-6.3. As stated in Section 3 of the Application, American Sands Energy and URS acknowledge the fact that the uppermost groundwater within the Affected Area is best characterized as shallow (less than 100 feet below ground surface (bgs)) as evidenced by discharge from the North Spring and other seeps near Range Creek. Although the amount of recharge for the groundwater system is inferred to be sparse and directly related to precipitation there is still a need to protect the resource. The shallow groundwater system is reported to follow an annual cycle related to snow melt, with discharge from springs during the spring of the year at approximately 40 gallons per minute (gpm), decreasing during summer and fall to less than 2 gpm. The fact that the springs flow throughout the year does however suggest that the shallow groundwater aquifer receives recharge and/or base flow in sufficient quantity to be a perennial resource and therefore relevant to the Application. These observations coupled with the preferential flow paths created by stress relief fractures and structural flexures that act as storage features and transport pathways for groundwater and any contaminants released into the system create a concern that the information presented in the Application is incomplete and that the associated risks to groundwater have not been adequately evaluated. There is a need to better understand the geologic and hydrogeologic systems in order to protect this limited resource, which is Class 1A "Pristine Water" as defined in Utah Code R317-6-3. The following comments are directly related to data gaps in the studies used to create the Application and concerns resulting from these data gaps that are potentially problematic if a surface or subsurface release should occur at the proposed site which would adversely impact the natural environment.

Implications Related to Current Geologic and Hydrogeologic Conditions Relative to the Potential Degradation of the Natural Environment and Protection of Class 1A Aquifer

Background information on the geologic and hydrogeologic conditions presented in the Application and the hydrology report included as Section 9 in this document state that shallow groundwater doesn't move downward and vertical movement is inhibited at greater depths. These statements are conjecture and not confirmed through testing.

<u>Stress Relief and Subsidence</u>
The primary concern that presents itself within the Application is that although it may be inferred that vertical migration is expected to be limited to nil, there is the significant potential for

preferential pathways to allow for saturated and unsaturated migration resulting from the secondary porosity and permeability features created by stress relief fractures at the surface that have been documented as effective snow mass melt recharge and storage to the springs, and the shallow groundwater system could effectively move contaminants in the event of a release even during dry periods.

Matrix or primary porosity is related to the intergranular porosity of the rock mass. Secondary porosity is related to joints or fractures within the primary rock mass that increase the permeability of the rock which makes it a much more conductive preferential pathway for groundwater and contaminant flow and migration. The secondary porosity features have the potential for increased preferential flow paths in the event that subsidence occurs within the footprint of the proposed tailings impoundment. This would increase the potential for contaminant migration within the fractured media created by the subsidence. The same potential is true for subsidence related to mining activities. The issue of subsidence in areas underlain by the mine workings will be driven by the mine layout, mine construction, and roof beam design. Specific details regarding the construction of the proposed room and pillar mine were not available in the documents reviewed. Should roof sag or collapse occur in the mine there is the potential that subsidence may occur and in part decrease the stability of the ground surface and increase secondary porosity features in the subsurface that can act as preferential pathways. Because the issues of subsidence is not properly addressed by the Application or Permit, the Permit does not protect against "impairment of present and future beneficial uses of groundwater" related to mine subsidence. R317-6-6.4.4.

Properties and Mobility of Residuals in Tailings

Beyond the physical, geologic, and hydrogeologic conditions, there is a major concern for the potential preferential contaminant migration as a result of the general compositional description of the proprietary solvents discussed in the Application to liberate the bitumen from the sand. The physical properties of the proprietary solvent and the residual concentrations estimated to be no greater than 25 parts per million (ppm) in the tailings do not provide enough information to determine risks and potential impacts to human health and the environment. The MSDS provided on page 148 of 499 of the Application indicates a specific gravity (SG) of 1.30 - 1.33 @ 20°C for the solvent while the SG of water is approximately 1 @ 20 degrees Celsius (°C) making the proprietary solvent a dense nonaqueous phase liquid (DNAPL). The solvent also has a reported molecular weight of 111.3429 as opposed to water which is 18.01528. Therefore, the physical properties of the proprietary solvent indicate that it has the potential to sink to the bottom of the tailing pile and to be mobile within the fractured bedrock matrix. Because the composition of the solvent has not been disclosed, it is not possible to evaluate the physical, chemical, or toxicological characteristics or effects of the solvent.

Appendix D of the Application provides a discussion of Fate and Transport of the residual solvents and attempts to argue that no phase separate migration of DNAPL would occur because of the sand tailing material's innate ability to trap and hold the nonaqueous phase liquid (NAPL). This retention ability is based upon the concept of residual saturation of the sand with respect to the NAPL. Residual saturation is a function of the porous medium characteristics such as porosity, heterogeneity and capillary forces along with properties of the NAPL such as viscosity and density. Because of the complex nature of the residual saturation of a specific porous medium and NAPL combination, it is very difficult and costly to measure site specific residual saturation. For this reason it is common practice to use literature values derived from laboratory studies of residual saturation when calculating retained volumes of NAPL as was done in the Application. Appendix D of the Application provides a rationale for selecting laboratory values that are relevant to the Bruin Point Mine sand tailings; however, assumptions regarding basic parameters necessarily carry implications regarding the reliability of the resulting conclusions. As an example, one of the scholarly papers referenced in Appendix D suggests that the values typically reported from laboratory studies of residual saturation are biased high and that actual in-situ values tend to be lower, suggesting that less solvent may actually be retained by the sand tailings than is estimated in the Application. An explanation of potential combined impacts of this and any other assumption inherent in the Appendix D calculations is important to a complete understanding of the risks presented by the tailings. For example, if the residual concentration of solvent in the tailings were substantially higher than the assumed 25 ppm and the residual saturation was much lower the combined affect may be that a release of phase separate solvent is possible. Appendix D does not include a discussion of this or any other assumptions that are inherent in the calculations of retention capacity of the sand tailing impoundment.
In addition to the potential for necessary assumptions to compound errors in calculated retention capacity, it appears that the residual bitumen left remaining in the sand tailings has not been accounted for in the residual saturation calculations. It is unlikely that the bitumen leaching process will remove 100% of the tar material originally present in the sand and any remaining hydrocarbon may affect the presumed residual saturation of the sand tailing thereby creating the potential for either bitumen or phase separate solvent to be released.

In other words, the residual solvent may lead to additional leached hydrocarbon components from the bitumen over time, well beyond the 5-year initial permit. This is especially true if the physical conditions within the tailings pile substantially change over time. For example, the compaction that will undoubtedly occur over time especially in the lower (deeper) portions of the tailings pile could reduce residual saturation and mobilize solvent, bitumen or a mixture of both. These same settlement and compaction related changes could cause changes in the tailings pile cover and/or liner that would result in failure of cap or liner integrity. A failure in integrity could then allow mobilized phase separate material to escape the tailings pile or allow an unplanned amount of water to infiltrate and contact the solvent or bitumen providing an additional potential transport mechanism. These changes and potential long-term effects could occur within the 5-

year initial permit or may take tens of years to manifest and threaten or degrade the groundwater and surface water in the area. For these reasons the mechanisms, likelihood and possible adverse effects should be thoroughly evaluated before disposal of tailings with residual solvent and bitumen are permitted in the impoundment or in the mine. In short, the Permit does not protect against "impairment of present and future beneficial uses of groundwater" related to residual solvent and bitumen in the tailings impoundment and mine. R317-6-6.4.4.

Once residual solvent and/or bitumen components are released into the environment, they can readily contaminate groundwater and nearby springs, perhaps before being detected by the monitoring program, potentially requiring a prolonged and costly remediation program. The proximity of the tailings impoundment, which is essentially a landfill utilizing an existing ravine, to the spring-fed headwaters of Range Creek and which is apparently within the drainage basin of Range Creek, poses a significant risk to these sensitive resources that does not appear to have been sufficiently evaluated. In recognition of the risks, siting alternatives should be developed, analyzed, and seriously considered before the permit is approved.

Impoundment Design

Finally, the discussion of the transport of any DNAPL that is mobilized in the tailings impoundment is incomplete. The statement in Appendix D that "the impoundment is designed to allow preferential flow of all liquids into the retention basin" is unsupported with respect to the specific behavior of a DNAPL. The design of the "weeping tile drain" placed on a low permeability clay liner is not explained in detail in Appendix D and it is not clear in reviewing other Sections of the Application that consideration of DNAPL flow behavior is adequately considered in the design of these impoundment elements. For example, it is not clear how vertical DNAPL flow under unsaturated conditions would necessarily be captured by a pipe network system. Several researchers have demonstrated that DNAPL movement in porous media is extremely susceptible to very minor changes in medium characteristics and capturing or controlling DNAPL movement is problematic under the best conditions. If a DNAPL is released into the subsurface, it can pool on the uppermost impermeable layer (lower confining unit) of the aquifer and bleed off dissolved contaminants over time. DNAPL is difficult if not impossible to fully remediate in the subsurface (particularly in bedrock) because, although it might pool, it has a propensity to break into residual pockets that may not be recoverable or treatable (Schwille, 1988).

In Section 8.4 of the Application, it was stated that lithologic conditions would inhibit downward movement of contaminants, but here it states the "semi-sealing" fractures/joints would prevent vertical migration. If the fractures are semi-sealing then there is the potential that a DNAPL could overcome the pore pressure in the fracture apertures to migrate downward and laterally with the potential to impact the aquifer. Infiltration galleries in contact with fractured bedrock to

allow for recharge of the shallow groundwater system and North Spring also have the potential to act as preferential pathways for contaminant migration.

Due to the reported limited recharge area referenced in Section 9.4.1 of the Application, the need to protect the groundwater resource is paramount and the diversion of onsite process/non-contact water increases the potential for impact from DNAPL in the event of a release. No site specific hydrogeologic data related to groundwater flow or the potentiometric surface for the shallow aquifer has been provided in the permit application.

American Sands reference in Section 9.4.2 in the Application, states that water occurring at 400 to 420 feet below ground surface (bgs) at less than 2 gpm fails to address the potential impacts to the uppermost shallow groundwater aquifer from proposed operations. Borings completed by Amoco in 1981 (A-14 and A-17, see pages 89 and 90 of the Application) indicated encountering water at 65 feet and 70 feet bgs, respectively. This occurrence was reported to be under artesian conditions, which is likely the result of locally confining conditions and the hydraulic head due to steep terrain. This observation is relevant because it demonstrates that groundwater is present at the site at <100 feet bgs. Artesian conditions also suggest the propensity for groundwater to move upward into the impoundment, despite the placement of a clay liner that would be susceptible to breaching. The referenced two borings were completed within and directly adjacent to the proposed dry material impoundment footprint, which suggests that groundwater is much closer to the potential source of solvent contamination than suggested in the Application. There is little indication that the risk of contaminating groundwater so close to the bottom of the impoundment has been adequately investigated or mitigated through either more strategic location of the impoundment or through its design. For these reasons, the Permit does not protect against "impairment of present and future beneficial uses of groundwater." R317-6-6.4.4.

Although there were numerous borings (see Figure 3-Geologic Map) completed at the facility by Amoco and others, there were only two logs presented in the Application hydrology report. A search of the Utah Division of Oil, Gas, and Mining (DOGM) and Utah Division of Water Rights well log data bases yielded no results for wells or test holes for Amoco or others in the general area of the proposed site. If ASE evaluated additional data, the evaluation should be provided for public review and verification. If the additional data was not obtained and/or evaluated, efforts should be made to obtain the data across at least 2 opposite seasonal cycles (i.e., 2 rainy seasons and 2 dry seasons) before siting the impoundment over the Class 1A aquifer.

Summary and Conclusions

While preventative measures are planned, there is still a high potential for release to the environment due to system/mechanical failures and human error, and the potential and associated

remedies for failure of those measures have not been fully-evaluated. It is not prudent to place this type of a facility over a Class 1A Pristine Water setting, as the proposed safeguards and engineering controls are insufficient to address the numerous leak and spill potentials through the process, storage, and transportation of solvent and bitumen.

Based on the Statement of Basis, Groundwater Discharge Permit UGW0700003 dated April 2015 and the Application, groundwater at the tailings disposal site is likely Class 1A as defined in UAC R317-6-3. The designation for Class 1A is Pristine Water and would be susceptible to contamination and impacts for the installation and operations of the tailings impoundment. This was confirmed by water quality analysis from a sample collected from the North Spring in 2012 by JBR and referenced by URS in the hydrology appendix included in the Application. The water sample was noted to be of high water quality with low concentrations of total dissolved solids (176 milligrams per kilogram).

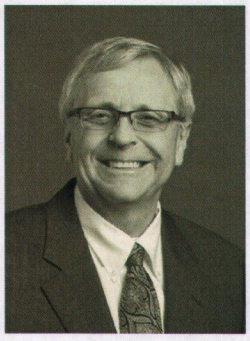
Among the data gaps are those related to site specific subsurface information on the geologic and hydrogeologic interaction of groundwater with surface water at the seeps and spring which represent the groundwater surface water interface. It is critical to fully characterize the geologic, hydrogeologic, and hydrologic conditions at the site. This is especially true given the specific properties of the proprietary solvent and its undisclosed composition, without which a proper risk assessment cannot be performed by the Department of Environmental Quality or other stakeholders. Finally, it is not clear that siting alternatives to mitigate the risks to groundwater, springs, and sensitive streams have been carefully considered; particularly as prudent siting could eliminate or greatly reduce such risks.

Because of the lack of a comprehensive hydrogeological model for the site as required by Utah Administrative Rule R317-6-6.3 regarding application contents, many of the provisions in the Permit do not appear to be adequate to ensure protection of the water resources. In order to provide better environmental protections, the Permit should be based upon an application that includes all of the required elements before the facilities are constructed. In either case, the Permit should adequately identify and address potential releases and related operational causes to provide the maximum protection possible to human health and the environment at the Bruin Point mine site.

JLB/jlb/sy

cc: file

JEFFREY BINDER, PG



Jeff Binder is an associate geologist and project manager for Burns & McDonnell. He is involved in the planning, direction, and completion of case studies, subsurface investigations, hydrogeologic studies, and remediation projects. His responsibilities include project management, field site management, geologic mapping, data collection for geologic and hydrogeologic studies, surface and downhole geophysical surveys, geologic research, site remediation, and preparation of geologic and engineering reports.

Jeff has worked on a wide variety of projects related to geology and hydrogeology. He has planned and directed numerous geological investigations including field work, research and report preparation for projects of varying scopes.

SPECIALTIES

- Geology
- Hydrogeology
- Geophysics
- Fractured Media
- Remedial & Subsurface Investigations
- Remediation
- Coalbed Methane
- Underground Mine Evaluation

EDUCATION

- MS, Urban Environmental Geology
- BS, Geology
- BA, Fine Arts
- AS, Mechanical Design

REGISTRATION

- Professional Geologist (AL, AZ, KS, FL, GA, IL, IN, MO, NE, NC, OR, TX)

25 YEARS WITH BURNS & MCDONNELL

27 YEARS OF EXPERIENCE

Geologic and Hydrogeologic Evaluation | Conoco Phillips

Borger, Texas | 2010-present

Project Hydrogeologist. The project involved the investigation, evaluation, and design of petroleum hydrocarbon controls and remedial measures at three areas at the WRB Borger Refinery. Currently performing an evaluation of the geologic and hydrogeologic conditions at the WRB Borger Refinery in Borger, Texas. The focus of this study to the analyze the surface and subsurface conditions relating to the transport and migration of petroleum hydrocarbons in the Ogallala Formation to aid in the selection and design of remedial alternatives to hydraulically control potential migration.

Aquifer Pumping Test | Corps of Engineers - Kansas City District

Former Nebraska Ordnance Plant, Mead Nebraska | 2008

Project Hydrogeologist. Planned, performed, and analyzed an aquifer pumping test at Extraction Well EW-1as part of a remedial investigation for the Operable Unit No. 2 area at the former Nebraska Ordnance Plant (NOR). The purpose of the test was to determine the maximum sustainable pumping rate and capture zone to aid in preparation of a numerical model relating to aquifer stream interaction.

Aquifer Pumping Test | US Corps of Engineers - Kansas City District

Former Schilling Air Force Base, Salina, Kansas | 2007

Project Hydrogeologist. Planned, designed, performed, and analyzed an aquifer pumping test as part of a remedial investigation for the OU-1 area, east of the former Schilling Air Force Base. The purpose of the test was to determine the pumping rate and capture zone for the potential design of a hydraulic containment system.

JEFFREY BINDER, PG
(continued)

Aquifer Pumping Test | Kansas Department of Health and Environment (KDHE)
Hutchinson, Kansas | 2006

Project Hydrogeologist. Conducted an aquifer pumping test on a groundwater extraction well which was part of a remediation system being designed and installed for the INEEDA Cleaners dry cleaning facility in Hutchinson, Kansas. He also analyzed and evaluated the test data prior to utilizing it in the remedial system design.

Fractured Bedrock Investigation | United Airlines Maintenance Operations Center
San Francisco, California | 2000-2001

Project Hydrogeologist. Planned and supervised fractured bedrock investigation for United Airlines at San Francisco International Airport. The investigation involved the characterization and evaluation of the presence and migration of chlorinated solvents in the Franciscan Formation bedrock underlying the facility. Geophysical and groundwater monitoring techniques were used in the collection of data for this project. Data was used to define potential for contaminant transport toward a nearby water supply well field and to identify feasibility for potential remediation technologies.

Waters of America, LLC
Washington County, Missouri | 2005

Project Manager and Hydrogeologist. Teamed with Haley & Aldrich to perform an evaluation of an existing spring water source in Washington County, Missouri. This evaluation included an evaluation of an existing spring capture configuration and an existing test well upslope of the spring capture area using a downhole camera. Based on the findings of this evaluation, recommendations were made for modifications of the spring catchment and primary filtration to improve yield and protect water quality.

Confidential Client
Miami, Florida | 2005-2006

Project Hydrogeologist. Evaluation of geologic and hydrogeologic conditions for a feasibility study for deep well injection for a manufacturing facility. Reviewed site specific and publicly available geologic and hydrogeologic data to determine the feasibility for the design and construction of a deep injection well.

City of Cape Girardeau, Missouri
Cape Girardeau, Missouri | 1999-2002

Project Hydrogeologist. Compiled data and performed groundwater modeling using THWELLS, MODFLOW, and TWODAN for well placement, aquifer yield, and aquifer response to pumping for proposed well field.

City of Cape Girardeau, Missouri
Cape Girardeau, Missouri | 1999-202

Project Hydrogeologist. Compiled data and performed groundwater modeling using THWELLS, MODFLOW, and TWODAN for well placement, aquifer yield, and aquifer response to pumping for proposed well field.

Dewatering Estimation and Groundwater Treatment, Public Service Electric & Gas Company
Hoboken, New Jersey | 2014

Project Hydrogeologist. Jeff coordinated the estimation and design for a temporary dewatering application to the North Hudson Sewerage Authority (NHSA) detailing the collection, treatment, and discharge of ground water collected during

excavation activities. Excavation dewatering estimates were established using calculated hydraulic conductivity values and proposed construction methodologies. A dewatering rate of approximately 90,000 gallons per day was estimated, with recovered water requiring pretreatment for metals and suspended solids prior to discharge.

Injection Well Study, Energy Client

Eastern Kansas, 2010

Project manager and Hydrogeologist. Study of a two-part feasibility study for an electrical generation client in northeastern Kansas to determine the potential for injecting wastes from flue gas desulphurization (FGD) blowdown into the subsurface. The first phase investigated the Arbuckle Formation, the primary zone in which injection wells are completed in Kansas. After determining that the Arbuckle was not sufficiently thick beneath the Owner's site, a second phase was performed to investigate an alternative injection zone consisting of the Hunton-Viola Group. Permitting issues, formation properties, and fluid composition were evaluated during the study, and a preliminary well design was performed. If permitted, this would be the first injection well in Kansas utilizing the Hunton-Viola.

Hydraulic Containment Systems, Williams Mid-Continent Fractionation and Storage, LLC, - Conway and Mitchell

Kansas | 2006-present

Project Hydrogeologist. Jeff planned and supervised the design and installation of groundwater interception trenches for hydraulic containment of chloride impacted groundwater plumes at the Conway East, Conway West, and Mitchell NGL storage facilities. These trenches were installed by using a one-pass trencher to depths ranging from 30 to 45 feet below existing ground surface. The groundwater collected by the hydraulic containment system was treated and pumped to on-site brine storage ponds for future use.

Williams Mid-Continent Fractionation and Storage, LLC - Conway and Mitchell

Kansas | 2005-2006

Project Hydrogeologist. Jeff planned and conducted aquifer testing and subsurface investigations related to the design and implementation of hydraulic containment systems for groundwater impacted with chlorides from brine ponds at the facilities. At the Mitchell facility a Hydraulic Profiling Tool (HPT) manufactured by Geoprobe® was used in combination with an electrical conductivity probe to identify potential migration pathways for the chloride impacted groundwater.

National Cooperative Refinery Association - Conway

Kansas | 2011-2012

Project Hydrogeologist. Jeff planned and conducted aquifer testing and subsurface investigations related to the design and implementation of hydraulic containment systems for groundwater impacted with chlorides at the facilities. At the NCRA Conway facility, a Hydraulic Profiling Tool (HPT) was used in combination with an electrical conductivity probe to identify potential migration pathways for the chloride impacted groundwater.

Coalbed Methane Pilot Study | Hoosier Rural Electric Cooperative

Merom, Indiana | 2010-2012

Project Hydrogeologist. Jeff has experience in study, design, and construction of Class I and Class II salt water disposal wells. In a recent project for a coalbed methane project in Indiana, he provided consulting service for installation of a 4,000 ft. Class II salt water disposal well. In charge of siting the well, coordination with IDNR concerning regulatory requirements, submission of the permit to IDNR and gaining final approval for operation of the well, interpretation of openhole and cased

geophysical logs, identification of the injection/disposal zones, well construction and completion, coordination of acidizing and treatment of the well, and mechanical integrity testing of the completed well for final acceptance of the well for operation by IDNR. He was also involved in the specification of the injection pump and other ancillary equipment for operation of the disposal well.

Coalbed Methane Pilot Study | Hoosier Rural Electric Cooperative
Merom, Indiana | 2008-2013

Petroleum Geologist for a coalbed methane pilot study. The study area is located near the eastern edge of the Illinois Basin in an area with proven coal reserves that have shown potential for development and utilization of CBM at the Merom power station. Responsibilities included developing a coalbed methane (CBM) field pilot production study for Hoosier Energy and was also involved in planning of the full scale development of a producing CBM field. Prior to these activities, he performed a study to evaluate the potential use of CBM utilization in the vicinity of the Hoosier power station near Merom, Indiana.

Coalmine Methane Energy Utilization Pre-Feasibility Study | Confidential Client
Western Colorado | 2009-2013

Petroleum Geologist involved in evaluating the potential alternatives for coalmine methane (CMM) utilization from an operating coal mine in western Colorado. Options that were evaluated included production of CMM for placement in a gas pipeline, utilization of CMM for cogeneration of electricity and flaring of CMM to meet air emission standards as well as mine operations safety. The study also required forecasting of reserves and production rates from two coal seams at the mine.

PRESENTATIONS

"Hydraulic Properties Analysis of Fractured Bedrock" presented February 28, 2003 at Missouri Groundwater Association Conference in Columbia Missouri.

"Microfracture Mapping & Geochemical Analysis Relative to Underground Natural Gas Storage Facilities, Central Kansas" presented September 23, 2011 at Association of Environmental and Engineering Geologists Annual Meeting in Anchorage, Alaska.

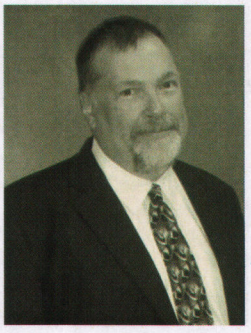
"Evaluation of Paleokarst Features and Potential Implications for Development of a Solid Waste Landfill Expansion, Central Missouri, USA" presented September 20, 2012 at Association of Environmental and Engineering Geologists Annual Meeting in Salt Lake City, Utah.

"Microfracture Mapping & Geochemical Analysis Relative to Underground Natural Gas Storage Facilities, Central Kansas" poster presentation May 21, 2012 at Battelle Remediation of Chlorinated and Recalcitrant Compounds Conference in Monterey, California.

"Proving the Effectiveness of Interceptor Trench for Hydraulic Containment of Chloride Impacted Groundwater at a Natural Gas Liquid Storage Facility, South Central Kansas, USA" presented September 19, 2013 at Association of Environmental and Engineering Geologists Annual Meeting

STEVE YOUNG, PG

Project Manager



Steve Young holds a Bachelor's degree in Earth Science and a Master's degree in Water Resources. He has experience and demonstrated success in groundwater related consulting throughout the U.S. on projects for all types of industry including chemical and hard goods manufacturing, oil and gas pipelines and refining and coal and mineral mining. His technical skills strengthen his ability to accomplish client economic goals while addressing environmental constraints. His thirty five years of experience includes groundwater resource evaluation, groundwater fate and transport modeling, environmental investigation and remediation of contaminated groundwater, program management, risk management, preparation of decision documents, and regulatory negotiation under both state and federal jurisdiction. Specific experience in support of oil and gas companies includes groundwater extraction and quality management in support of regional groundwater resource management challenges as well as groundwater quality investigation and remediation along pipeline facilities. In addition to his broad and relevant business sector experience Steve also has recent experience in Wyoming investigating and evaluating groundwater resources in Campbell County and in Sheridan County.

SPECIALTIES

- Hydrogeology
- Groundwater Resource Management
- Groundwater Modeling
- Decision Support
- Regulatory Negotiation
- Remediation Design
- Environmental Characterization

EDUCATION

- MAS, Water Resources
- BS, Earth Science/Geology

REGISTRATION

- Professional Geologist (PA, WY)

4 YEARS WITH BURNS & MCDONNELL

35 YEARS OF EXPERIENCE

GENERAL EXPERIENCE

Steve has experience in each of the following areas:

- Hydrogeology/Contaminant Chemistry
- Groundwater Resource Evaluation
- Groundwater Flow and Transport Modeling
- Environmental Program Risk Management
- Site Investigations
- Regulatory Negotiations Concerning Remediation, Compliance and Enforcement Matters
- Remediation Selection, Design and Implementation
- Environmental Litigation Support

Groundwater Resource Investigation | Campbell County Public Works

Gillette, Wyoming | 2013-Present

Steve is currently leading an extensive groundwater investigation to characterize the existing groundwater resources in preparation for a municipal waste landfill expansion in Campbell County. The investigation includes the drilling and construction of nearly 40 wells, hydraulic testing of select wells, interpretation of data including construction of detailed geologic sections and preparation of a report for submittal to Wyoming DEQ. The report will outline the conceptual site

model with emphasis on groundwater resources that may be impacted by proposed landfill development activities and will suggest potential mitigation measures as appropriate.

Groundwater Resource Monitoring and Investigation Design | City of Sheridan
Sheridan, Wyoming | 2013-Present

Steve is currently managing a project focused on monitoring groundwater at an existing waste disposal facility and is working with client representatives and regulatory officials to develop a groundwater investigation designed to evaluate local groundwater resources. The investigation will be designed to characterize groundwater resources surrounding the disposal facility that may be adversely impacted by disposal activities.

Groundwater Extraction System Optimization | Confidential Manufacturing Client
Albuquerque, New Mexico | 2006-Present

Steve is currently providing numerical groundwater flow and particle tracking model support for an active groundwater recovery and plume control pumping system at a Superfund site in New Mexico. The confidential Fortune 500 client is managing a VOC plume in order to minimize adverse impact on surrounding water supply system wells while simultaneously managing operating costs. The plume control system includes both groundwater extraction and injection wells which are maintained as balanced as part of the successful operation of the system. The groundwater flow model is used on a routine basis to evaluate and adjust extraction and injection rates in response to regional flow changes, shifts in pumping demand, extraction and injection well efficiency changes and maintenance requirements.

Groundwater Flow Modeling in support of Supply Management and Plume Containment | NCRA Refinery
McPherson, Kansas | 2011, ERM, Inc.

Steve revised and updated a three-dimensional groundwater flow model in order to help manage groundwater resources in a sensitive hydrogeologic regime. The multiple goals of the withdrawal planning included supplying water to refinery activities and managing a contaminant plume while not exacerbating regional saline water intrusion into a protected aquifer. Groundwater injection was evaluated as a option for supplementing the groundwater flow management efforts. This project represents an ongoing management challenge and the modeling effort was combined with a three-dimensional geologic block model in an effort to better understand and visualize predicted aquifer responses.

Ground Water Modeling | AeroJet
Baldwin Park, California | 2000 – 2003, MACTEC, Inc.*

As Technical Director Steve guided the development and application of a groundwater model used to assist a California client in managing groundwater resources of an entire basin in the San Bernardino basin. Program challenges included financial risk in cost allocation and groundwater remediation design and implementation. The development of a three-dimensional finite element groundwater flow and particle tracking model for a superfund site in Baldwin Park, CA supported the use of three-dimensional visualization of contaminant distribution in the basin. Together these technologies allowed the successful communication of pumping effects and remediation effectiveness within the basin thereby bounding the clients risk and facilitating resource management decisions.

STEVE YOUNG, PG
(continued)

Technical Risk Management Strategy | Phillips Petroleum
Borger, Texas | 1998 – 2000, Weston Solutions*

As the Technical Director, Steve collaborated on development of a technical risk management strategy for a confidential refinery facility in Western Texas that was involved in a law suit over environmental damages from product leakage. The strategy included participation as the subject matter expert in the development of environmental database for and the development of GIS-based mapping solutions. He also directed the development of a three-dimensional geospatial data analysis of geologic data in support of contaminant pathway analysis and the subsequent construction of a three-dimensional physical model for display in legal proceedings. The strategy was successful in that the combination of complete mastery of the site data along with the physical geologic model encouraged the opposition to settle the case out of court thereby saving the client considerable expense.